

3. RESULTS

3.1 Introduction and Totals

The results of compiling the contaminant inventory information for 1994 through 1999 are discussed in this section.

3.2 Argonne National Laboratory-West

Summary results of both nonradiological and radiological contaminants from ANL-W are discussed in the following paragraphs and presented in the associated tables.

3.2.1 Nonradiological Contaminants

The recorded inventory of nonradiological contaminants in waste from ANL-W is listed in Table 3-1. The primary, nonradiological contaminant was asbestos (826,000 g [1,821 lb]). Asbestos is not classified as hazardous waste in accordance with RCRA. Therefore, asbestos contaminated with radionuclides is still acceptable for burial at the SDA. Asbestos was generated primarily during facility maintenance and modification operations. In addition, a small amount of treated mercury from a treatability study of crushed mercury lights was disposed of at the SDA, and a one-time shipment of treated NaK from EBR-I was accepted and buried at the SDA. However, because both the mercury and NaK were treated, they are not recorded as nonradiological contaminants.

Table 3-1. Inventory of nonradiological contaminants from Argonne National Laboratory-West from 1994 to 1999.

CAS Number	Chemical	Best Estimate (g)	Upper Bound (g)
1332-21-4	Asbestos	8.26E+05	1.24E+06

3.2.2 Radiological Contaminants

The inventory of radiological contaminants in the waste from ANL-W is listed in Tables 3-2 and 3-3.

The best estimate for the total radioactivity from 1984 to 1993 is approximately 2.08E+04 Ci. The largest contributors to the radioactivity are activation products. Cobalt-60 makes up about half of the activity at 1.02E+04 Ci. The next two largest contributors are Co-57 at 7.04E+03 Ci and Mn-54 at 1.69E+03 Ci. The other key activation products are Ni-63, Na-22, and Co-58. The predominant fission products include Sr-90, Cs-137, Y-90, and Ce-144.

3.3 Test Reactor Area

3.3.1 Nonradiological Contaminants

Between 1984 and 1994, TRA sent 6,300 kg (7 tons) of beryllium and 1,600 kg (1.8 tons) of lead to the RWMC. The lead was from shielding and the beryllium from the ATR reactor core. Though it was projected that about 50,000 kg (55 tons) of beryllium could have been sent to the RWMC between 1994 and 2003, none has been since 1994. No lead or other nonradiological contaminant was projected to be sent or has been sent from TRA.

Table 3-2. Inventory of radiological contaminants (listed by quantity) from Argonne National Laboratory-West from 1994 to 1999 (activity at time of disposal).

Radionuclide	Best Estimate (Ci)	Percent of Total (%)	Upper Bound
Co-60	1.02E+04	48.7	2.29E+04
Co-57	7.04E+03	33.8	7.04E+03
Mn-54	1.69E+03	8.1	3.71E+03
Ni-63	1.01E+03	4.8	5.98E+03
Co-58	4.61E+02	2.2	7.66E+02
Na-22	3.67E+02	1.8	5.64E+03
Ni-59	2.07E+01	0.10	8.02E+01
Cs-137	1.89E+01	0.09	2.90E+01
Sr-90	1.80E+01	0.09	1.03E+02
Y-90	1.79E+01	0.09	1.06E+02
Ce-144	1.18E+01	0.06	4.86E+01
Sr-89	8.68E+00	<0.05	5.14E+01
C-14	7.11E+00	<0.05	1.97E+01
Ru-106	3.45E+00	<0.05	1.62E+01
Zr-95	3.34E+00	<0.05	1.67E+01
Fe-59	1.80E+00	<0.05	2.23E+00
Nb-95	1.61E+00	<0.05	3.65E+00
Cr- ⁵¹	1.56E+00	<0.05	3.06E+00
Pu-241	1.45E+00	<0.05	4.16E+03
Sb-125	7.74E-01	<0.05	3.18E+00
H-3	7.74E-01	<0.05	1.95E+02
Eu-155	6.46E-01	<0.05	2.57E+00
Cs-134	6.10E-01	<0.05	2.50E+00
Nb-94	2.68E-01	<0.05	6.39E-01
Eu-154	1.10E-01	<0.05	4.25E+00
Ta-182	9.24E-02	<0.05	2.03E-01
Pu-239	3.60E-02	<0.05	1.78E-01
Sn-113	2.86E-02	<0.05	1.41E-01
Pu-240	2.75E-02	<0.05	1.11E+00
Pu-238	2.04E-02	<0.05	1.00E-01
Am-241	1.60E-02	<0.05	1.23E+03

Table 3-2. (continued).

Radionuclide	Best Estimate (Ci)	Percent of Total (%)	Upper Bound
Np-237	7.59E-03	<0.05	3.75E-02
Ba-140	4.91E-03	<0.05	2.95E-02
U-235	3.18E-03	<0.05	1.57E-02
Tc-99	2.64E-03	<0.05	4.15E-03
U-234	1.69E-03	<0.05	8.34E-03
U-238	1.66E-03	<0.05	8.21E-03
I-129	1.56E-03	<0.05	1.32E+01
Ag-110m	1.31E-03	<0.05	7.86E-03
Eu-152	1.23E-03	<0.05	1.88E-03
Sb-124	1.21E-03	<0.05	6.04E-03
La-140	8.25E-04	<0.05	4.20E-03
U-233	5.69E-04	<0.05	2.81E-03
Cm-244	8.73E-05	<0.05	4.15E-04
U-232	4.70E-06	<0.05	2.30E-05
I-131	4.50E-06	<0.05	2.29E-05
Th-228	1.66E-06	<0.05	8.18E-06
Th-230	2.02E-07	<0.05	9.98E-07
Pa-231	1.60E-08	<0.05	7.89E-08
Sn-117m	1.70E-09	<0.05	8.49E-09
Pu-242	1.03E-09	<0.05	5.06E-09
Ac-227	1.01E-09	<0.05	4.98E-09
Th-229	3.46E-10	<0.05	1.71E-09
Am-243	2.15E-10	<0.05	1.06E-09
Ra-226	1.29E-10	<0.05	1.97E-10
Pb-210	3.76E-12	<0.05	5.72E-12
Cl-36	2.76E-12	<0.05	2.76E-12
Th-232	2.02E-14	<0.05	9.99E-14
Ra-228	1.47E-15	<0.05	2.25E-15
Te-132	6.71E-17	<0.05	1.03E-16
U-236	0.00E+00	<0.05	0.00E+00
Total	2.08E+04	100.0	—

Table 3-3. Inventory of radiological contaminants (listed alphabetically) from Argonne National Laboratory-West from 1994 to 1999 (activity at time of disposal).

Radionuclide	Best Estimate (Ci)	Percent of Total (%)	Upper Bound
Ac-227	1.01E-09	<0.05	4.98E-09
Ag-110m	1.31E-03	<0.05	7.86E-03
Am-241	1.60E-02	<0.05	1.23E+03
Am-243	2.15E-10	<0.05	1.06E-09
Ba-140	4.91E-03	<0.05	2.95E-02
C-14	7.11E+00	<0.05	1.97E+01
Ce-144	1.18E+01	0.06	4.86E+01
Cl-36	2.76E-12	<0.05	2.76E-12
Cm-244	8.73E-05	<0.05	4.15E-04
Co-57	7.04E+03	33.8	7.04E+03
Co-58	4.61E+02	2.2	7.66E+02
Co-60	1.02E+04	48.7	2.29E+04
Cr-51	1.56E+00	<0.05	3.06E+00
Cs-134	6.10E-01	<0.05	2.50E+00
Cs-137	1.89E+01	0.09	2.90E+01
Eu-152	1.23E-03	<0.05	1.88E-03
Eu-154	1.10E-01	<0.05	4.25E+00
Eu-155	6.46E-01	<0.05	2.57E+00
Fe-59	1.80E+00	<0.05	2.23E+00
H-3	7.74E-01	<0.05	1.95E+02
I-129	1.56E-03	<0.05	1.32E+01
I-131	4.50E-06	<0.05	2.29E-05
La-140	8.25E-04	<0.05	4.20E-03
Mn-54	1.69E+03	8.1	3.71E+03
Na-22	3.67E+02	1.8	5.64E+03
Nb-94	2.68E-01	<0.05	6.39E-01
Nb-95	1.61E+00	<0.05	3.65E+00
Ni-59	2.07E+01	0.10	8.02E+01
Ni-63	1.01E+03	4.8	5.98E+03
Np-237	7.59E-03	<0.05	3.75E-02
Pa-231	1.60E-08	<0.05	7.89E-08

Table 3-3. (continued).

Radionuclide	Best Estimate (Ci)	Percent of Total (%)	Upper Bound
Pb-210	3.76E-12	<0.05	5.72E-12
Pu-238	2.04E-02	<0.05	1.00E-01
Pu-239	3.60E-02	<0.05	1.78E-01
Pu-240	2.75E-02	<0.05	1.11E+00
Pu-241	1.45E+00	<0.05	4.16E+03
Pu-242	1.03E-09	<0.05	5.06E-09
Ra-226	1.29E-10	<0.05	1.97E-10
Ra-228	1.47E-15	<0.05	2.25E-15
Ru-106	3.45E+00	<0.05	1.62E+01
Sb-124	1.21E-03	<0.05	6.04E-03
Sb-125	7.74E-01	<0.05	3.18E+00
Sn-113	2.86E-02	<0.05	1.41E-01
Sn-117m	1.70E-09	<0.05	8.49E-09
Sr-89	8.68E+00	<0.05	5.14E+01
Sr-90	1.80E+01	0.09	1.03E+02
Ta-182	9.24E-02	<0.05	2.03E-01
Tc-99	2.64E-03	<0.05	4.15E-03
Te-132	6.71E-17	<0.05	1.03E-16
Th-228	1.66E-06	<0.05	8.18E-06
Th-229	3.46E-10	<0.05	1.71E-09
Th-230	2.02E-07	<0.05	9.98E-07
Th-232	2.02E-14	<0.05	9.99E-14
U-232	4.70E-06	<0.05	2.30E-05
U-233	5.69E-04	<0.05	2.81E-03
U-234	1.69E-03	<0.05	8.34E-03
U-235	3.18E-03	<0.05	1.57E-02
U-236	0.00E+00	<0.05	0.00E+00
U-238	1.66E-03	<0.05	8.21E-03
Y-90	1.79E+01	0.09	1.06E+02
Zr-95	3.34E+00	<0.05	1.67E+01
Total	2.08E+04	100.0	—

3.3.2 Radiological Contaminants

The overall results for the revised IWTS database using the scaling factors are listed by category in Table 3-4. The total-radioactivity best estimate for the period from 1994 to 1999 is approximately 13,000 Ci. The ATR reactor core parts compose the bulk of the activity with Fe-55 and Co-60 being the major contributors. The source of the radioactivity of the NPR targets, which are made of lithium, is almost entirely tritium.

Table 3-4. Summary of data by waste stream from the Integrated Waste Tracking System database.

Waste Stream	Gross Weight (g)	Gross Volume (m ³)	IWTS Activity (Ci)	Best-Estimate Activity (Ci)	Upper-Bound Activity ^a (Ci)
Resins	188,451,000	181.3	692.8	823.3	1,345.6
Noncompactible waste	95,526,000	326.9	5.0	5.4	6.3
ATR reactor core parts	1,263,000	5.3	8,097.6	8,108.4	27,596.1
Hot cell waste	6,150,000	20.1	147.9	147.9	147.9
NPR targets	249,000	0.9	4,173.0	4,173.0	8,346.0
Sludge	3,552,000	5.4	0.00062	0.00062	0.00062
Portland cemented waste	279,000	0.5	0.0059	0.0059	0.0059
Totals	295,470,000	540.4	13,116.3	13,258.0	37,441.9

ATR = Advanced Test Reactor

IWTS = Integrated Waste Tracking System

NPR = New Production Reactor

a. The values shown include totals of miscellaneous radionuclides.

The total nuclide activities sent to RWMC by year from 1994 to 1999 are listed in Table 3-5. The large amount of activity in 1995 is caused by ATR reactor core parts from the 1994 core changeout. The high activity level in 1997 is from the NPR-irradiated target material (TRISO targets).

Revised estimates of radioactivity were calculated for the resins and the noncompactible waste, using Tables 2-7 and 2-8. Cobalt-60 data were available in all cases. In the rare instances when Cs-137 data were missing, Cs-137 was calculated from the Cs-137/Co-60 scaling factor. The Pu-239 values had to be calculated from the Pu-239/Co-60 scaling factor nearly all the time. However, the contribution of the TRU waste to the overall radioactivity of a waste stream was relatively insignificant in all cases. The core-parts activities were reassessed, as described above, to include long-lived radionuclides that were not in the original activity assessments.

Upper-bound activity was calculated, in accordance with the RPDT (LMITCO 1995a, Section 5). Upper bounds were calculated using the scaling data in Tables 2-7 and 2-8 for the radionuclides listed for the resins and noncompactible waste. When a data value was missing, the upper-bound scaling factor was used to calculate one. When a data value was listed, multiplying the data value by one and adding the relative standard deviation, increased the data value.

Table 3-5. Summary of data by year from the Integrated Waste Tracking System database.

Year	Gross Weight (g)	Gross Volume (m ³)	IWTS Activity (Ci)	Best-Estimate Activity (Ci)	Upper-Bound Activity ^a (Ci)
1994	104,273,000	196.1	317.0	434.8	599.2
1995	67,695,000	139.8	8,225.7	8,238.3	27,940.4
1996	18,471,000	24.4	105.2	105.4	154.2
1997	45,956,000	35.0	4,232.0	4,235.8	8,442.2
1998	42,175,000	100.6	103.3	104.5	136.9
1999	16,900,000	44.5	133.1	139.2	169.0
Totals	295,470,000	540.4	13,116.3	13,258.0	37,441.9

IWTS = Integrated Waste Tracking System

a. The values shown include totals of miscellaneous radionuclides.

An upper-bound value for the core parts was determined by using the methods in the RPDT (LMITCO 1995a, Section 5.4.5). An upper-bound value was calculated for radionuclides with associated entries for each of the seven shipments by using Equation (5-15) in the RPDT (LMITCO 1995a, Section 5.4.5). This equation calculates a two-sigma value for the upper-bound activity, which can be seen in Table 3-5, and is substantially larger than the best-estimate value. However, nearly 90% of the curie activity is from Fe-55 (half-life = 3 years) and Zn-65 (half-life = 244 days) so that consequences of long-term storage are minimal.

The NPR targets also show a large upper-bound estimate consisting almost entirely of tritium. The estimate is based on the same upper-bound estimate for tritium in the beryllium reflectors in the ATR reactor core (Einerson 1995, p. 22). The bounds are given as +100% and -50%. Therefore, the upper-bound estimate is double the best-estimate value.

Because of the unknown nature of the hot cell waste, and the insignificant amount of activity in the sludge and Portland cemented waste, upper-bound estimates were not calculated, except as described below.

A relative standard deviation of five was assumed and applied to the totals for all years for all miscellaneous radionuclides not listed in Tables 2-7 and 2-8, or otherwise updated as suggested in the RPDT (LMITCO 1995a, Section 5.4.3). The upper-bound totals in Tables 3-3 and 3-4 do not include these additions.

The revised radionuclide inventory is listed for waste shipped to the RWMC from TRA from 1994 to 1999 in Tables 3-5 and 3-6. Nearly all of the Fe-55 and Zn-55 activity is attributable to reactor parts shipped in 1994 and 1995, and the H-3 activity comes from the NPR irradiated target material (i.e., lithium), as it is described in the IWTS database. Other contributors such as the activation products Co-58, Co-60, Ni-63, Cr-51, and Mn-54, and the fission product Cs-137 are what generally would be expected based on the nature of the reactor operations that generated the waste. The unusually high Ir-192 and europium activities are the result of operations in the hot cells. The inventory is listed in alphabetical order in Table 3-7.

Table 3-6. Inventory of radiological contaminants from the Test Reactor Area (listed by quantity) from 1994 to 1999 (activity at time of disposal).

Radionuclide	Best Estimate (Ci)	Percent of Total (%)	Upper Bound (Ci)
Fe-55	4.76E+03	35.90	2.22E+04
H-3	4.17E+03	31.48	8.35E+03
Zn-65	2.24E+03	16.87	1.34E+04
Co-60	1.01E+03	7.63	2.15E+03
Cr-51	5.09E+02	3.84	7.43E+02
Ni-63	1.72E+02	1.30	7.75E+02
Mn-54	1.57E+02	1.18	7.06E+02
Ir-192	6.98E+01	0.53	4.19E+02
Sc-46	3.39E+01	0.26	2.03E+02
Eu-154	3.20E+01	0.24	3.32E+01
Eu-155	1.99E+01	0.15	2.05E+01
Eu-152	1.94E+01	0.15	1.16E+02
Co-58	1.37E+01	0.10	2.23E+01
Cs-137	1.18E+01	0.09	2.35E+01
Sn-119m	9.12E+00	0.07	5.48E+01
Hf-181	8.44E+00	0.06	5.07E+01
Pu-241	4.90E+00	<0.05	2.94E+01
Sr-90	3.67E+00	<0.05	3.97E+00
C-14	2.02E+00	<0.05	4.84E+00
Ni-59	1.58E+00	<0.05	8.18E+00
Am-241	1.35E+00	<0.05	8.11E+00
Rh-106	1.25E+00	<0.05	7.07E-02
Ba-137m	9.73E-01	<0.05	5.84E+00
Sb-125	9.47E-01	<0.05	5.68E+00
Ce-144	6.12E-01	<0.05	2.90E+00
Fe-59	5.74E-01	<0.05	3.45E+00
Sb-124	4.69E-01	<0.05	2.82E+00
Y-90	3.39E-01	<0.05	2.03E+00
Nb-94	3.36E-01	<0.05	1.96E+00
Pm-147	3.06E-01	<0.05	1.84E+00
Cs-134	2.22E-01	<0.05	1.33E+00
I-132	1.51E-01	<0.05	9.06E-01
Ce-141	1.48E-01	<0.05	8.88E-01
Sr-89	1.46E-01	<0.05	8.75E-01
Zr-95	9.79E-02	<0.05	5.87E-01

Table 3-6. (continued).

Radionuclide	Best Estimate (Ci)	Percent of Total (%)	Upper Bound (Ci)
Cm-242	9.06E-02	<0.05	5.43E-01
Gd-153	8.74E-02	<0.05	5.24E-01
Nb-95	7.31E-02	<0.05	4.38E-01
I-131	5.96E-02	<0.05	3.58E-01
Pu-238	5.89E-02	<0.05	3.54E-01
La-140	5.75E-02	<0.05	3.45E-01
Ba-140	4.54E-02	<0.05	2.72E-01
Cm-244	4.25E-02	<0.05	2.54E-01
Hf-175	4.13E-02	<0.05	2.48E-01
Rh-105	4.04E-02	<0.05	7.74E+00
Se-75	2.91E-02	<0.05	1.74E-01
Sb-122	2.80E-02	<0.05	1.68E-01
Mo-99	2.16E-02	<0.05	1.30E-01
Ag-108m	1.79E-02	<0.05	1.08E-01
Na-24	1.64E-02	<0.05	9.86E-02
Pu-239	1.50E-02	<0.05	7.84E-02
Rh-103m	1.30E-02	<0.05	7.78E-02
Co-57	1.00E-02	<0.05	6.02E-02
Ru-103	9.71E-03	<0.05	0.00E+00
Th-232	8.17E-03	<0.05	8.17E-03
Pu-240	8.16E-03	<0.05	4.86E-02
W-187	6.06E-03	<0.05	3.64E-02
Ag-110	5.27E-03	<0.05	3.16E-02
Ta-182	3.63E-03	<0.05	2.18E-02
Mo-93	3.42E-03	<0.05	2.05E-02
Tc-99	3.36E-03	<0.05	2.01E-02
U-234	1.40E-03	<0.05	1.40E-03
Np-237	8.49E-04	<0.05	7.31E-03
Kr-85	8.90E-04	<0.05	5.34E-03
I-129	6.85E-04	<0.05	4.11E-03
U-236	5.24E-04	<0.05	5.24E-04
Pa-234m	4.86E-04	<0.05	2.92E-03
Sn-121m	3.16E-04	<0.05	1.90E-03
Sn-113	7.14E-05	<0.05	4.28E-04
U-238	7.07E-05	<0.05	7.07E-05
Th-234	3.76E-05	<0.05	3.76E-05

Table 3-6. (continued).

Radionuclide	Best Estimate (Ci)	Percent of Total (%)	Upper Bound (Ci)
U-235	3.15E-05	<0.05	3.15E-05
In-113m	2.17E-05	<0.05	1.30E-04
Ru-106	5.72E-06	<0.05	3.43E-05
Th-230	5.20E-06	<0.05	5.20E-06
Cl-36	2.95E-06	<0.05	1.77E-05
Zr-93	2.63E-06	<0.05	1.58E-05
Nb-93m	2.34E-06	<0.05	1.40E-05
Os-194	1.55E-06	<0.05	9.30E-06
U-233	1.24E-07	<0.05	1.24E-07
Th-228	1.13E-07	<0.05	1.13E-07
I-124	3.10E-08	<0.05	1.86E-07
Ba-133	7.08E-09	<0.05	4.25E-08
K-40	5.00E-09	<0.05	3.00E-08
Po-210	1.14E-11	<0.05	6.82E-11
Totals	13258.4186	100.00	49359.56402

Table 3-7. Inventory of radiological contaminants from the Test Reactor Area (listed alphabetically) for the years 1994 to 1999 (activity at time of disposal).

Radionuclide	Best Estimate (Ci)	Percent of Total (%)	Upper Bound (Ci)
Ag-108m	1.79E-02	<0.05	1.08E-01
Ag-110	5.27E-03	<0.05	3.16E-02
Am-241	1.35E+00	<0.05	8.11E+00
Ba-133	7.08E-09	<0.05	4.25E-08
Ba-137m	9.73E-01	<0.05	5.84E+00
Ba-140	4.54E-02	<0.05	2.72E-01
C-14	2.02E+00	<0.05	4.84E+00
Ce-141	1.48E-01	<0.05	8.88E-01
Ce-144	6.12E-01	<0.05	2.90E+00
Cl-36	2.95E-06	<0.05	1.77E-05
Cm-242	9.06E-02	<0.05	5.43E-01
Cm-244	4.25E-02	<0.05	2.54E-01
Co-57	1.00E-02	<0.05	6.02E-02
Co-58	1.37E+01	0.10	2.23E+01
Co-60	1.01E+03	7.63	2.15E+03
Cr-51	5.09E+02	3.84	7.43E+02
Cs-134	2.22E-01	<0.05	1.33E+00
Cs-137	1.18E+01	0.09	2.35E+01
Eu-152	1.94E+01	0.15	1.16E+02
Eu-154	3.20E+01	0.24	3.32E+01
Eu-155	1.99E+01	0.15	2.05E+01
Fe-55	4.76E+03	35.90	2.22E+04
Fe-59	5.74E-01	<0.05	3.45E+00
Gd-153	8.74E-02	<0.05	5.24E-01
H-3	4.17E+03	31.48	8.35E+03
Hf-175	4.13E-02	<0.05	2.48E-01
Hf-181	8.44E+00	0.06	5.07E+01
I-124	3.10E-08	<0.05	1.86E-07
I-129	6.85E-04	<0.05	4.11E-03
I-131	5.96E-02	<0.05	3.58E-01
I-132	1.51E-01	<0.05	9.06E-01

Table 3-7. (continued).

Radionuclide	Best Estimate (Ci)	Percent of Total (%)	Upper Bound (Ci)
In-113m	2.17E-05	<0.05	1.30E-04
Ir-192	6.98E+01	0.53	4.19E+02
K-40	5.00E-09	<0.05	3.00E-08
Kr-85	8.90E-04	<0.05	5.34E-03
La-140	5.75E-02	<0.05	3.45E-01
Mn-54	1.57E+02	1.18	7.06E+02
Mo-93	3.42E-03	<0.05	2.05E-02
Mo-99	2.16E-02	<0.05	1.30E-01
Na-24	1.64E-02	<0.05	9.86E-02
Nb-93m	2.34E-06	<0.05	1.40E-05
Nb-94	3.36E-01	<0.05	1.96E+00
Nb-95	7.31E-02	<0.05	4.38E-01
Ni-59	1.58E+00	<0.05	8.18E+00
Ni-63	1.72E+02	1.30	7.75E+02
Np-237	8.98E-04	<0.05	7.31E-03
Os-194	1.55E-06	<0.05	9.30E-06
Pa-234m	4.86E-04	<0.05	2.92E-03
Pm-147	3.06E-01	<0.05	1.84E+00
Po-210	1.14E-11	<0.05	6.82E-11
Pu-238	5.89E-02	<0.05	3.54E-01
Pu-239	1.50E-02	<0.05	7.84E-02
Pu-240	8.16E-03	<0.05	4.86E-02
Pu-241	4.90E+00	<0.05	2.94E+01
Rh-103m	1.30E-02	<0.05	7.78E-02
Rh-105	4.04E-02	<0.05	7.74E+00
Rh-106	1.25E+00	<0.05	7.07E-02
Ru-103	9.71E-03	<0.05	0.00E+00
Ru-106	5.72E-06	<0.05	3.43E-05
Sb-122	2.80E-02	<0.05	1.68E-01
Sb-124	4.69E-01	<0.05	2.82E+00
Sb-125	9.47E-01	<0.05	5.68E+00
Sc-46	3.39E+01	0.26	2.03E+02

Table 3-7. (continued).

Radionuclide	Best Estimate (Ci)	Percent of Total (%)	Upper Bound (Ci)
Se-75	2.91E-02	<0.05	1.74E-01
Sn-113	7.14E-05	<0.05	4.28E-04
Sn-119m	9.12E+00	0.07	5.48E+01
Sn-121m	3.16E-04	<0.05	1.90E-03
Sr-89	1.46E-01	<0.05	8.75E-01
Sr-90	3.67E+00	<0.05	3.97E+00
Ta-182	3.63E-03	<0.05	2.18E-02
Tc-99	3.36E-03	<0.05	2.01E-02
Th-228	1.13E-07	<0.05	1.13E-07
Th-230	5.20E-06	<0.05	5.20E-06
Th-232	8.17E-03	<0.05	8.17E-03
Th-234	3.76E-05	<0.05	3.76E-05
U-233	1.24E-07	<0.05	1.24E-07
U-234	1.40E-03	<0.05	1.40E-03
U-235	3.15E-05	<0.05	3.15E-05
U-236	5.24E-04	<0.05	5.24E-04
U-238	7.07E-05	<0.05	7.07E-05
W-187	6.06E-03	<0.05	3.64E-02
Y-90	3.39E-01	<0.05	2.03E+00
Zn-65	2.24E+03	16.87	1.34E+04
Zr-93	2.63E-06	<0.05	1.58E-05
Zr-95	9.79E-02	<0.05	5.87E-01
Total	13258.4194	100.00	49359.56402

3.4 Test Area North

3.4.1 Nonradiological Contaminants

As anticipated, no nonradiological contaminants were shipped from TAN to the RWMC during the 1994 to 1999 timeframe.

3.4.2 Radiological Contaminants

The inventory of radiological contaminants in waste from TAN are listed in Tables 3-8 and 3-9.

The best estimate for the total quantity of radioactive material shipped from TAN to the SDA from 1994 through 1999 is approximately Ci-558. The majority of the activity listed is Fe-55, followed by Co-60 and H-3.

Table 3-8. Inventory of radionuclide contaminants from Test Area North (listed by quantity) for the years 1994 to 1999 (activity at time of disposal).

Radionuclide	Best Estimate (Ci)	Percent of Total (%)	Upper Bound (Ci)
Fe-55	2.20E+02	39.48	4.41E+02
Co-60	1.59E+02	28.46	3.18E+02
H-3	8.72E+01	15.63	5.23E+02
Co-58	2.47E+01	4.43	1.48E+02
Ni-63	2.43E+01	4.35	4.86E+01
Sr-90	2.00E+01	3.58	1.20E+02
Cr-51	1.16E+01	2.08	6.97E+01
Cs137	6.23E+00	1.12	1.25E+01
U-234	1.89E+00	0.34	1.89E+00
U-238	7.87E-01	0.14	7.87E-01
Mn-54	4.08E-01	0.07	2.45E+00
Ba-137m	3.01E-01	0.05	1.80E+00
Ni-59	2.71E-01	0.05	1.62E+00
Am-241	2.30E-01	<0.05	1.38E+00
Ce-144	2.24E-01	<0.05	1.35E+00
Ag-110m	1.68E-01	<0.05	1.01E+00
Sb-125	1.52E-01	<0.05	9.12E-01
Pu-241	5.54E-02	<0.05	3.32E-01
U-235	4.85E-02	<0.05	4.85E-02
Pu-240	3.99E-02	<0.05	2.39E-01
Eu-154	3.83E-02	<0.05	2.30E-01

Table 3-8. (continued).

Radionuclide	Best Estimate (Ci)	Percent of Total (%)	Upper Bound (Ci)
Pu-238	3.82E-02	<0.05	2.29E-01
Y-90	3.25E-02	<0.05	1.95E-01
Cm-242	3.02E-02	<0.05	1.81E-01
Pu-239	2.89E-02	<0.05	1.73E-01
Cs-134	1.94E-02	<0.05	1.16E-01
Th-232	1.60E-02	<0.05	1.60E-02
Nb-94	1.31E-02	<0.05	7.89E-02
Eu-152	1.23E-02	<0.05	7.38E-02
Th-228	7.55E-03	<0.05	7.55E-03
Ra-226	5.05E-03	<0.05	5.05E-03
Ru-106	3.61E-03	<0.05	2.17E-02
Cm-244	3.29E-03	<0.05	1.97E-02
Tc-99	2.66E-03	<0.05	1.60E-02
Th-230	2.36E-03	<0.05	2.36E-03
Eu-155	1.62E-03	<0.05	9.70E-03
Th-234	1.52E-03	<0.05	1.52E-03
C-14	1.40E-03	<0.05	8.41E-03
Hf-181	3.79E-04	<0.05	2.27E-03
Ag-108m	2.59E-04	<0.05	1.55E-03
Zr-95	1.43E-04	<0.05	8.58E-04
K-40	4.21E-05	<0.05	2.53E-04
I-129	3.77E-05	<0.05	2.26E-04
Zn-65	3.17E-05	<0.05	1.90E-04
U-236	3.12E-06	<0.05	3.12E-06
Pm-147	4.60E-14	<0.05	2.76E-13
Totals	5.58E+02	100.00	1.70E+03

Table 3-9. Radionuclide inventory (listed alphabetically) from Test Area North for the years 1994 to 1999 (activity at time of disposal).

Radionuclide	Best Estimate (Ci)	Percent of Total (%)	Upper Bound (Ci)
Ag-108m	2.59E-04	<0.05	1.55E-03
Ag-110m	1.68E-01	<0.05	1.01E+00
Am-241	2.30E-01	<0.05	1.38E+00
Ba-137m	3.01E-01	0.05	1.80E+00
C-14	1.40E-03	<0.05	8.41E-03
Ce-144	2.24E-01	<0.05	1.35E+00
Cm-242	3.02E-02	<0.05	1.81E-01
Cm-244	3.29E-03	<0.05	1.97E-02
Co-58	2.47E+01	4.43	1.48E+02
Co-60	1.59E+02	28.46	3.18E+02
Cr-51	1.16E+01	2.08	6.97E+01
Cs-134	1.94E-02	<0.05	1.16E-01
Cs-137	6.23E+00	1.12	1.25E+01
Eu-152	1.23E-02	<0.05	7.38E-02
Eu-154	3.83E-02	<0.05	2.30E-01
Eu-155	1.62E-03	<0.05	9.70E-03
Fe-55	2.20E+02	39.48	4.41E+02
H-3	8.72E+01	15.63	5.23E+02
Hf-181	3.79E-04	<0.05	2.27E-03
I-129	3.77E-05	<0.05	2.26E-04
K-40	4.21E-05	<0.05	2.53E-04
Mn-54	4.08E-01	0.07	2.45E+00
Nb-94	1.31E-02	<0.05	7.89E-02
Ni-59	2.71E-01	0.05	1.62E+00
Ni-63	2.43E+01	4.35	4.86E+01
Pm-147	4.60E-14	<0.05	2.76E-13
Pu-238	3.82E-02	<0.05	2.29E-01
Pu-239	2.89E-02	<0.05	1.73E-01
Pu-240	3.99E-02	<0.05	2.39E-01
Pu-241	5.54E-02	<0.05	3.32E-01
Ra-226	5.05E-03	<0.05	5.05E-03

Table 3-9. (continued).

Radionuclide	Best Estimate (Ci)	Percent of Total (%)	Upper Bound (Ci)
Ru-106	3.61E-03	<0.05	2.17E-02
Sb-125	1.52E-01	<0.05	9.12E-01
Sr-90	2.00E+01	3.58	1.20E+02
Tc-99	2.66E-03	<0.05	1.60E-02
Th-228	7.55E-03	<0.05	7.55E-03
Th-230	2.36E-03	<0.05	2.36E-03
Th-232	1.60E-02	<0.05	1.60E-02
Th-234	1.52E-03	<0.05	1.52E-03
U-234	1.89E+00	0.34	1.89E+00
U-235	4.85E-02	<0.05	4.85E-02
U-236	3.12E-06	<0.05	3.12E-06
U-238	7.87E-01	0.14	7.87E-01
Y-90	3.25E-02	<0.05	1.95E-01
Zn-65	3.17E-05	<0.05	1.90E-04
Zr-95	1.43E-04	<0.05	8.58E-04
Totals	5.58E+02	100.00	1.70E+03

3.5 Specific Manufacturing Capability

3.5.1 Nonradiological Contaminants

No nonradiological contaminants were shipped by SMC to the RWMC from 1994 to 1999. This was anticipated in the RPDT (LMITCO 1995a) for the 1994 to 2003 timeframe.

3.5.2 Radiological Contaminants

The activity totals are listed in Tables 3-10 and 3-11 for the various SMC waste streams and for each year waste was shipped. The greatest contributor to radionuclide activity is the unsolidified slag shipped in 1994 and 1995. The majority of the waste, by weight and volume, is the depleted uranium-contaminated waste made up of metals and general debris. The best-estimate activities for 1994 and 1995 are greatly increased over the activities listed in the IWTS database (see Table 3-11). This increase can be explained by the fact that, for those years, the only radionuclide listed was U-238. The activity was, therefore, increased substantially when the scaling factors were applied. In contrast, the IWTS database listed most of the concerned radionuclides for 1998 and 1999; therefore, little change resulted from applying scaling factors.

The total radionuclide inventory alphabetically and by quantity is listed in Tables 3-12 and 3-13. Ninety percent of the activity comes from U-238, Th-234, and Pa-234m, with the rest of the uranium and thorium nuclides making up the remaining bulk. The listed TRU waste contributes a negligible amount of activity.

Table 3-10. Summary of Specific Manufacturing Capability data by waste category.

Waste Stream	Gross Weight (g)	Gross Volume (m ³)	IWTS Activity (Ci)	Best-Estimate Activity (Ci)	Upper-Bound Activity (Ci)
Nonacidic evaporator sludge	11,464,000	14.5	0.17	0.57	1.33
Unsolidified slag	21,454,000	12.0	2.31	7.80	17.99
Depleted uranium contaminated material	393,612,639	762.7	0.72	0.82	1.96
Sand blast grit	4,784,038	2.9	0.01	0.01	0.02
Totals	431,314,677	792.2	3.21	9.19	21.29

Table 3-11. Summary of Specific Manufacturing Capability waste shipments by year.

Year	Gross Weight (g)	Gross Volume (m ³)	IWTS Activity (Ci)	Best-Estimate Activity (Ci)	Upper-Bound Activity (Ci)
1994	33,770,000	34.1	1.99	6.71	15.47
1995	4,843,000	5.1	0.52	1.77	4.07
1998	249,712,125	494.8	0.53	0.55	1.33
1999	142,989,552	258.1	0.17	0.18	0.41
Totals	431,314,677	792.2	3.21	9.19	21.29

Table 3-12. Specific Manufacturing Capability radionuclide inventory (listed alphabetically) from 1994 through 1999 (activity at time of disposal).

Radionuclide	Best Estimate (Ci)	Percent of Total (%)	Upper Bound (Ci)
Am-241	3.21E-05	< 0.05	8.86E-05
Np-239	1.86E-05	< 0.05	3.54E-05
Pa-234m	2.70E+00	29.36	8.10E+00
Pu-238	2.84E-06	< 0.05	5.05E-06
Pu-239	4.62E-06	< 0.05	7.21E-06
Tc-99	1.51E-03	< 0.05	2.29E-03
Th-231	3.48E-02	0.38	1.04E-01
Th-234	2.80E+00	30.47	8.40E+00
U-232	4.72E-03	0.05	1.42E-02
U-233	3.50E-01	3.81	1.05E+00
U-234	5.16E-01	5.61	8.15E-01
U-235	3.47E-02	0.38	3.82E-02
Am-241	5.10E-02	0.55	6.02E-02
Np-239	2.70E+00	29.37	2.70E+00

Table 3-13. Specific Manufacturing Capability radionuclide inventory (listed by quantity) from 1994 through 1999 (activity at time of disposal).

Radionuclide	Best Estimate (Ci)	Percent of Total (%)	Upper Bound (Ci)
Th-234	2.80E+00	30.47	8.40E+00
U-238	2.70E+00	29.37	2.70E+00
Pa-234M	2.70E+00	29.36	8.10E+00
U-234	5.16E-01	5.61	8.15E-01
U-233	3.50E-01	3.81	1.05E+00
U-236	5.10E-02	0.55	6.02E-02
Th-231	3.48E-02	0.38	1.04E-01
U-235	3.47E-02	0.38	3.82E-02
U-232	4.72E-03	0.05	1.42E-02
Tc-99	1.51E-03	< 0.05	2.29E-03
Am-241	3.21E-05	< 0.05	8.86E-05
Np-239	1.86E-05	< 0.05	3.54E-05
Pu-239	4.62E-06	< 0.05	7.21E-06
Pu-238	2.84E-06	< 0.05	5.05E-06

3.6 Idaho Nuclear Technology and Engineering Center

3.6.1 Nonradiological Contaminants

Asbestos is the only nonradiological contaminant sent to the RWMC from INTEC between 1994 and 1999. Almost 2 million g (2.2 tons) of asbestos were shipped in 1994. From 1995 to 1998, less than 1 million g (1.1 tons) were sent each year. However, in 1999, 31.5 million g (35 tons) of asbestos were shipped from INTEC, making a total of 35.4 million g (39 tons) sent to the RWMC for the period (see Table 3-14).

Table 3-14. Inventory of nonradiological contaminants from Idaho Nuclear Technology and Engineering Center from 1994 to 1999.

CAS Number	Chemical	Best Estimate (g)	Upper Bound (g)
1332-21-4	Asbestos	3.54E+07	5.32E+07

3.6.2 Radiological Contaminants

A summary of information contained in the IWTS database, in addition to the updated activities calculated as part of this work, is listed in Table 3-15. Throughout the 1994 to 1999 timeframe, only one waste stream, consisting mostly of construction and cleanup materials, was sent to the RWMC from INTEC. The total of 50 Ci is somewhat less than the 160 Ci projected for this period. This reduction reflects a continuing emphasis on minimization of waste and changes in programs.

Table 3-15. Year-by-year summary of waste shipments from the Idaho Nuclear Technology and Engineering Center to the Radioactive Waste Management Complex.

Year	Gross Weight (g)	Gross Volume (m ³)	Integrated Waste Tracking System Activity (Ci)	Best-Estimate Activity (Ci)	Upper-Bound Activity (Ci)
1994	77,483,800	127.2	2.5	2.6	9.5
1995	103,835,400	156.7	24.5	28.1	114.8
1996	74,521,500	145.0	4.8	5.0	18.4
1997	70,245,459	150.5	1.37	1.41	5.7
1998	153,439,413	726.7	8.6	8.8	36.2
1999	414,578,437	975.7	4.0	4.1	21.6
Totals	894,104,009	2281.7	45.7	50.0	206.2

The radiological inventory of waste from INTEC that was sent to RWMC during the period 1994 to 1999 is listed in Tables 3-16 and 3-17. The revised or best estimates of radioactivity were calculated using the data contained in Table 2-18. In several cases, Co-60 data were not listed; therefore, radionuclide curie values based on the Co-60 scaling factors could not be calculated. All shipments listed Cs-137 data. In most cases, Pu-239 data were not listed. In such cases, Pu-239 values were generated using the Pu-239/Co-60 scaling factor, when necessary.

Upper bounds were calculated in accordance with the RPDT (LMITCO 1995a, Section 5). The upper bounds for radionuclides not listed in Table 2-18 were calculated assuming a relative standard deviation of 5, in accordance with the RPDT (LMITCO 1995a, Table 5-2).

Table 3-16. Inventory of radiological contaminants from the Idaho Nuclear Technology and Engineering Center (listed by quantity) for the years 1994 to 1999 (activity at time of disposal).

Radionuclide	Best Estimate (Ci)	Percent of Total (%)	Upper Bound (Ci)
Zr-95	2.26E+01	45.28	4.52E+01
Y-90	1.05E+01	21.00	6.29E+01
Ba-137m	4.89E+00	9.79	2.93E+01
Ce-144	2.87E+00	5.74	1.72E+01
Fe-55	2.83E+00	5.66	1.70E+01
Co-60	1.35E+00	2.71	8.11E+00
Pm-147	9.77E-01	1.96	5.86E+00
Sb-125	8.50E-01	1.70	5.10E+00
Ni-63	6.47E-01	1.30	3.88E+00
Co-58	5.50E-01	1.10	3.30E+00
Am-241	5.21E-01	1.04	3.12E+00
U-234	4.90E-01	0.98	9.79E-01
Pu-239	1.73E-01	0.35	3.46E-01

Table 3-16. (continued).

Radionuclide	Best Estimate (Ci)	Percent of Total (%)	Upper Bound (Ci)
H-3	1.57E-01	0.31	9.44E-01
Tc-99	1.07E-01	0.21	6.42E-01
Cs-134	1.06E-01	0.21	2.12E-01
Pu-238	9.81E-02	0.20	5.88E-01
Cm-242	5.66E-02	0.11	3.40E-01
Cm-244	3.51E-02	0.07	2.03E-01
Sm-151	2.59E-02	0.05	1.56E-01
Pu-240	2.56E-02	0.05	1.54E-01
U-235	2.00E-02	< 0.05	1.20E-01
Np-237	1.61E-02	< 0.05	9.66E-02
U-238	1.42E-02	< 0.05	8.50E-02
U-236	1.30E-02	< 0.05	7.78E-02
Te-125m	1.20E-02	< 0.05	7.20E-02
C-14	7.95E-03	< 0.05	4.77E-02
Rh-106	2.75E-03	< 0.05	1.65E-02
Ru-106	1.88E-03	< 0.05	9.60E-03
U-233	5.74E-04	< 0.05	3.44E-03
Ni-59	5.65E-04	< 0.05	5.65E-04
Cd-113m	5.27E-04	< 0.05	5.38E-04
I-129	4.72E-04	< 0.05	2.83E-03
Th-232	2.85E-04	< 0.05	1.71E-03
Mn-54	2.56E-04	< 0.05	1.53E-03
Th-230	2.55E-04	< 0.05	1.53E-03
Zr-93	2.02E-04	< 0.05	2.02E-04
Th-229	1.49E-04	< 0.05	8.94E-04
Nb-93m	4.33E-05	< 0.05	2.60E-04
Th-228	2.48E-05	< 0.05	1.49E-04
Cs-135	1.24E-05	< 0.05	1.24E-05
Ra-226	1.18E-05	< 0.05	7.06E-05
Zn-65	9.46E-06	< 0.05	9.46E-06
Se-79	7.56E-06	< 0.05	4.54E-05
Fe-59	4.01E-06	< 0.05	4.01E-06
Co-57	3.26E-06	< 0.05	1.95E-05
Sb-126	2.83E-06	< 0.05	2.83E-06
Sn-126	2.77E-06	< 0.05	1.66E-05
Nb-95	2.18E-06	< 0.05	1.31E-05

Table 3-16. (continued).

Radionuclide	Best Estimate (Ci)	Percent of Total (%)	Upper Bound (Ci)
Cm-243	1.86E-06	< 0.05	1.11E-05
Ag-110m	1.26E-06	< 0.05	7.55E-06
Sn-121m	1.10E-06	< 0.05	6.63E-06
Sm-147	1.09E-06	< 0.05	6.56E-06
Zr-95	1.02E-06	< 0.05	6.11E-06
Y-90	1.02E-06	< 0.05	6.11E-06
Ba-137m	3.54E-07	< 0.05	2.12E-06
Ce-144	3.47E-07	< 0.05	2.08E-06
Fe-55	3.37E-07	< 0.05	2.02E-06
Co-60	9.55E-08	< 0.05	5.73E-07
Pm-147	6.72E-13	< 0.05	4.03E-12

Table 3-17. Inventory of radiological contaminants from INTEC (listed alphabetically) for the years 1994 to 1999 (activity at time of disposal).

Radionuclide	Best Estimate (Ci)	Percent of Total (%)	Upper Bound (Ci)
Ag-110m	3.37E-07	< 0.05	2.02E-06
Am-241	5.66E-02	0.11	3.40E-01
Ba-137m	5.50E-01	1.10	3.30E+00
C-14	2.85E-04	< 0.05	1.71E-03
Cd-113m	4.33E-05	< 0.05	2.60E-04
Ce-144	5.21E-01	1.04	3.12E+00
Cm-242	1.30E-02	< 0.05	7.78E-02
Cm-243	3.47E-07	< 0.05	2.08E-06
Cm-244	1.20E-02	< 0.05	7.20E-02
Co-57	1.09E-06	< 0.05	6.56E-06
Co-58	9.81E-02	0.20	5.88E-01
Co-60	1.73E-01	0.35	3.46E-01
Cs-134	1.61E-02	< 0.05	9.66E-02
Cs-135	2.77E-06	< 0.05	1.66E-05
Cs-137	2.26E+01	45.28	4.52E+01
Eu-152	4.89E+00	9.79	2.93E+01
Eu-154	2.87E+00	5.74	1.72E+01
Eu-155	9.77E-01	1.96	5.86E+00

Table 3-17. (continued).

Radionuclide	Best Estimate (Ci)	Percent of Total (%)	Upper Bound (Ci)
Fe-55	4.90E-01	0.98	9.79E-01
Fe-59	1.10E-06	< 0.05	6.63E-06
H-3	2.56E-02	0.05	1.54E-01
I-129	2.48E-05	< 0.05	1.49E-04
Mn-54	1.18E-05	< 0.05	7.06E-05
Nb-93m	3.26E-06	< 0.05	1.95E-05
Nb-95	3.54E-07	< 0.05	2.12E-06
Ni-59	1.49E-04	< 0.05	8.94E-04
Ni-63	1.06E-01	0.21	2.12E-01
Np-237	5.74E-04	< 0.05	3.44E-03
Pm-147	1.57E-01	0.31	9.44E-01
Pr-144	1.35E+00	2.71	8.11E+00
Pu-238	1.42E-02	< 0.05	8.50E-02
Pu-239	2.59E-02	0.05	1.56E-01
Pu-240	2.75E-03	< 0.05	1.65E-02
Pu-241	2.83E+00	5.66	1.70E+01
Ra-226	2.18E-06	< 0.05	1.31E-05
Rh-106	2.56E-04	< 0.05	1.53E-03
Ru-106	2.55E-04	< 0.05	1.53E-03
Sb-125	1.07E-01	0.21	6.42E-01
Sb-126	1.02E-06	< 0.05	6.11E-06
Se-79	1.26E-06	< 0.05	7.55E-06
Sm-147	6.72E-13	< 0.05	4.03E-12
Sm-151	7.95E-03	< 0.05	4.77E-02
Sn-121m	9.55E-08	< 0.05	5.73E-07
Sn-126	1.02E-06	< 0.05	6.11E-06
Sr-90	1.05E+01	21.00	6.29E+01
Tc-99	2.00E-02	< 0.05	1.20E-01
Te-125m	4.72E-04	< 0.05	2.83E-03
Th-228	2.83E-06	< 0.05	2.83E-06
Th-229	4.01E-06	< 0.05	4.01E-06
Th-230	9.46E-06	< 0.05	9.46E-06

Table 3-17. (continued).

Radionuclide	Best Estimate (Ci)	Percent of Total (%)	Upper Bound (Ci)
Th-232	1.24E-05	< 0.05	1.24E-05
U-233	2.02E-04	< 0.05	2.02E-04
U-234	3.51E-02	0.07	2.03E-01
U-235	1.88E-03	< 0.05	9.60E-03
U-236	5.27E-04	< 0.05	5.38E-04
U-238	5.65E-04	< 0.05	5.65E-04
Y-90	6.47E-01	1.30	3.88E+00
Zn-65	1.86E-06	< 0.05	1.11E-05
Zr-93	7.56E-06	< 0.05	4.54E-05
Zr-95	8.50E-01	1.70	5.10E+00

3.7 Naval Reactors Facility

Summary results of both nonradiological and radiological contaminants are discussed in the following paragraphs and presented in associated tables.

3.7.1 Nonradiological Contaminants

The inventory of nonradiological contaminants in the waste from NRF is listed in Table 3-18. Asbestos was identified as the only nonradiological contaminant. An estimated total of 2.65 million g (3 tons) of asbestos was contained in the waste shipped from NRF. Asbestos is not classified as hazardous waste in accordance with RCRA; therefore, asbestos contaminated with radionuclides is still acceptable for burial at the SDA. The waste was generated primarily during facility maintenance and modification operations.

Table 3-18. Inventory of nonradiological contaminants from Argonne National Laboratory-West (listed by quantity) for the years 1994 to 1999.

CAS Number	Chemical	Best Estimate (g)	Upper Bound
1332-21-4	Asbestos	2.65E+06	5.30E+06

3.7.2 Radiological Contaminants

The inventory of radiological contaminants in the waste from NRF is listed in Tables 3-19 and 3-20.

The best estimate for the total quantity of radioactive material shipped from NRF to the SDA from 1994 through 1999 is approximately 88,900 Ci. The majority of the activity listed is Ni-63, followed by Co-60 and Fe-55.

Table 3-19. Inventory of radiological contaminants from the Naval Reactors Facility (listed by activity) for the years 1994 to 1999 (activity at time of disposal).

Radionuclide	Best Estimate (Ci)	Percent of Total (%)	Upper Bound (Ci)
Ni-63	5.13E+04	57.7	1.20E+05
Co-60	1.65E+04	18.6	3.93E+04
Fe-55	1.59E+04	17.9	3.82E+04
Sb-125	1.51E+03	1.7	1.51E+03
Co-58	1.39E+03	1.6	3.33E+03
Mn-54	4.68E+02	0.5	1.97E+03
Ni-59	4.17E+02	0.5	4.17E+02
Ta-182	4.10E+02	0.5	4.10E+02
Nb-95	3.83E+02	0.4	9.00E+02
Co-57	1.87E+02	0.2	1.87E+02
Eu-154	1.11E+02	0.1	1.11E+02
Zr-95	1.10E+02	0.1	1.10E+02
Eu-155	6.03E+01	0.1	6.03E+01
Cr-51	8.92E+01	<0.05	2.10E+02
H-3	1.76E+01	<0.05	4.16E+01
Nb-94	1.56E+01	<0.05	1.56E+01
C-14	8.74E+00	<0.05	2.16E+01
Sn-113	4.57E+00	<0.05	4.57E+00
Cs-134	2.08E+00	<0.05	2.08E+00
Cs-137	1.30E+00	<0.05	2.66E+00
Eu-152	6.32E-01	<0.05	6.32E-01
Sr-90	6.21E-01	<0.05	1.49E+00
Y-90	5.75E-01	<0.05	1.38E+00
Pu-241	4.76E-01	<0.05	4.76E-01
Ru-106	4.72E-01	<0.05	4.72E-01
Tc-99	2.27E-01	<0.05	5.18E-01
Fe-59	1.74E-01	<0.05	1.74E-01
Cl-36	9.21E-02	<0.05	9.21E-02
Ce-144	6.58E-02	<0.05	6.58E-02
Sb-124	4.26E-02	<0.05	4.26E-02
Cm-244	3.24E-02	<0.05	3.24E-02

Table 3-19. (continued).

Radionuclide	Best Estimate (Ci)	Percent of Total (%)	Upper Bound (Ci)
Am-241	2.90E-02	<0.05	2.90E-02
Pu-238	2.80E-02	<0.05	2.80E-02
Sr-89	1.41E-02	<0.05	1.41E-02
Pu-239	8.62E-03	<0.05	8.62E-03
Pu-240	3.85E-03	<0.05	3.85E-03
I-129	9.05E-04	<0.05	3.29E-03
Ag-110	6.43E-04	<0.05	6.43E-04
Ba-140	2.70E-05	<0.05	2.70E-05
U-235	2.98E-06	<0.05	2.98E-06
U-238	1.82E-06	<0.05	1.19E-05
U-234	1.77E-06	<0.05	1.77E-06
Am-243	1.44E-06	<0.05	1.44E-06
U-232	7.12E-07	<0.05	7.12E-07
Ac-227	0.00E+00	0.00	0.00E+00
I-131	0.00E+00	0.00	0.00E+00
La-140	0.00E+00	0.00	0.00E+00
Na-22	0.00E+00	0.00	0.00E+00
Np-237	0.00E+00	0.00	0.00E+00
Pa-231	0.00E+00	0.00	0.00E+00
Pb-210	0.00E+00	0.00	0.00E+00
Pu-242	0.00E+00	0.00	0.00E+00
Ra-226	0.00E+00	0.00	0.00E+00
Ra-228	0.00E+00	0.00	0.00E+00
Te-132	0.00E+00	0.00	0.00E+00
Th-228	0.00E+00	0.00	0.00E+00
Th-229	0.00E+00	0.00	0.00E+00
Th-230	0.00E+00	0.00	0.00E+00
Th-232	0.00E+00	0.00	0.00E+00
U-233	0.00E+00	0.00	0.00E+00
U-236	0.00E+00	0.00	0.00E+00
Sn-117m	0.00E+00	0.00	0.00E+00
Total	8.89E+04	99.8	—

Table 3-20. Inventory of radiological contaminants from the Naval Reactors Facility (listed alphabetically) for the years 1994 to 1999 (activity at time of disposal).

Radionuclide	Best Estimate (Ci)	Percent of Total (%)	Upper Bound
Ac-227	0.00E+00	0.00	0.00E+00
Ag-110	6.43E-04	< 0.05	6.43E-04
Am-241	2.90E-02	< 0.05	2.90E-02
Am-243	1.44E-06	< 0.05	1.44E-06
Ba-140	2.70E-05	< 0.05	2.70E-05
C-14	8.74E+00	< 0.05	2.16E+01
Ce-144	6.58E-02	< 0.05	6.58E-02
Cl-36	9.21E-02	< 0.05	9.21E-02
Cm-244	3.24E-02	< 0.05	3.24E-02
Co-57	1.87E+02	0.2	1.87E+02
Co-58	1.39E+03	1.6	3.33E+03
Co-60	1.65E+04	18.6	3.93E+04
Cr-51	8.92E+01	< 0.05	2.10E+02
Cs-134	2.08E+00	< 0.05	2.08E+00
Cs-137	1.30E+00	< 0.05	2.66E+00
Eu-152	6.32E-01	< 0.05	6.32E-01
Eu-154	1.11E+02	0.1	1.11E+02
Eu-155	6.03E+01	0.1	6.03E+01
Fe-55	1.59E+04	17.9	3.82E+04
Fe-59	1.74E-01	< 0.05	1.74E-01
H-3	1.76E+01	< 0.05	4.16E+01
I-129	9.05E-04	< 0.05	3.29E-03
I-131	0.00E+00	0.00	0.00E+00
La-140	0.00E+00	0.00	0.00E+00
Mn-54	4.68E+02	0.5	1.97E+03
Na-22	0.00E+00	0.00	0.00E+00
Nb-94	1.56E+01	< 0.05	1.56E+01
Nb-95	3.83E+02	0.4	9.00E+02
Ni-59	4.17E+02	0.5	4.17E+02
Ni-63	5.13E+04	57.7	1.20E+05
Np-237	0.00E+00	0.00	0.00E+00

Table 3-20. (continued).

Radionuclide	Best Estimate (Ci)	Percent of Total (%)	Upper Bound
Pa-231	0.00E+00	0.00	0.00E+00
Pb-210	0.00E+00	0.00	0.00E+00
Pu-238	2.80E-02	< 0.05	2.80E-02
Pu-239	8.62E-03	< 0.05	8.62E-03
Pu-240	3.85E-03	< 0.05	3.85E-03
Pu-241	4.76E-01	< 0.05	4.76E-01
Pu-242	0.00E+00	0.00	0.00E+00
Ra-226	0.00E+00	0.00	0.00E+00
Ra-228	0.00E+00	0.00	0.00E+00
Ru-106	4.72E-01	< 0.05	4.72E-01
Sb-124	4.26E-02	< 0.05	4.26E-02
Sb-125	1.51E+03	1.7	1.51E+03
Sn-113	4.57E+00	< 0.05	4.57E+00
Sn-117m	0.00E+00	0.00	0.00E+00
Sr-89	1.41E-02	< 0.05	1.41E-02
Sr-90	6.21E-01	< 0.05	1.49E+00
Ta-182	4.10E+02	0.5	4.10E+02
Tc-99	2.27E-01	< 0.05	5.18E-01
Te-132	0.00E+00	0.00	0.00E+00
Th-228	0.00E+00	0.00	0.00E+00
Th-229	0.00E+00	0.00	0.00E+00
Th-230	0.00E+00	0.00	0.00E+00
Th-232	0.00E+00	0.00	0.00E+00
U-232	7.12E-07	< 0.05	7.12E-07
U-233	0.00E+00	0.00	0.00E+00
U-234	1.77E-06	< 0.05	1.77E-06
U-235	2.98E-06	< 0.05	2.98E-06
U-236	0.00E+00	0.00	0.00E+00
U-238	1.82E-06	< 0.05	1.19E-05
Y-90	5.75E-01	< 0.05	1.38E+00
Zr-95	1.10E+02	0.1	1.10E+02
Total	8.89E+04	99.8	—

3.8 Other Waste Generators

Other waste generators include the Auxiliary Reactor Area; the Central Facilities Area; Deactivation, Decontamination and Decommissioning; the Power Burst Facility; WAG 1; WAG 3; WAG 7; WERF; and the Waste Management Facility (WMF). Other waste generators are INEEL waste generators that contribute relatively insignificant quantities of waste for burial at the SDA.

3.8.1 Nonradiological Contaminants

Asbestos was the only nonradiological contaminant shipped to the SDA from the other waste generators. The total amount of asbestos generated from WERF and from D&D&D activities is 3,732,746 g (4 tons).

3.8.2 Radiological Contaminants

The inventory of radiological contaminants, by quantity, from the other waste generators for the years 1994 to 1999 is listed in Table 3-21. The inventory of radiological contaminants, alphabetically, from the other waste generators for the years 1994 to 1999 is listed in Table 3-22.

The best estimate for the total quantity of radioactive material shipped from the other waste generators from 1994 through 1999 is approximately 192.46 Ci.

3.8.3 Scaling Factors

Curie inventories were so small in the case of facilities listed as other waste generators that attempts to update them with scaling factors were not considered. Upper bounds were calculated using the generic relative standard deviations found in the RPDT (LMITCO 1995a, Section 5.4.3). These generic numbers are derived from EPRI data (EPRI 1987).

Table 3-21. Inventory of radiological contaminants from other waste generators^a (listed by quantity) for the years 1994 to 1999 (activity at the time of disposal).

Radionuclide	Best Estimate (Ci)	Percent of Total (%)	Upper Bound
Y-90	82.1830487	42.70096603	13.09829221
Mn-54	25.9543154	13.48543718	168.4769059
Ni-63	24.3146014	12.63346864	48.63206761
Ce-144	11.50705096	5.978875207	23.01550411
Pr-144	10.72107237	5.570493604	24.62600009
Zr-95	9.220731095	4.790940851	69.52483364
Tc-99	6.673637069	3.467512514	58.0570199
Ru-106	4.425874294	2.299611792	25.02322257
Rh-106	4.342574248	2.256330453	26.05544549
Nb-95	3.189978438	1.657460548	6.479957132
Co-58	0.88275108	0.458663003	5.296506478
U-238	0.881236338	0.457875968	5.287418028

Table 3-21. (continued).

Radionuclide	Best Estimate (Ci)	Percent of Total (%)	Upper Bound
Pu-241	0.862918599	0.448358371	5.177511596
Eu-155	0.642868796	0.334024097	3.857460762
Th-234	0.607233308	0.315508481	3.643399849
Pa-234m	0.561378118	0.291682875	3.368268706
C-14	0.543537389	0.282413125	3.261224334
Cr-51	0.409780803	0.212915393	2.458684818
Cs-134	0.404902105	0.210380502	0.522832207
Sb-125	0.387513959	0.201345906	2.389893099
Eu-152	0.379366764	0.197112757	2.286912131
Fe-59	0.365490824	0.189903046	0.365490824
Ag-110m	0.364471482	0.189373413	2.186828894
Ra-226	0.356522148	0.185243069	2.139132888
Zn-65	0.2709282	0.140769855	1.625569198
Eu-154	0.23221058	0.120652814	1.393263478
Pu-239	0.164468857	0.085455324	1.070075147
Ag-108m	0.15742927	0.08179767	0.944121618
U-234	0.133787535	0.069513812	0.80272521
Sc-46	0.114549041	0.059517806	0.687294248
Ni-59	0.074079077	0.038490275	0.074079077
Am-241	0.067108159	0.0348683	0.402648952
Sm-151	0.065044531	0.033796073	0.39190992
Pu-240	0.061589474	0.032000882	0.37511765
Ba-140	0.052901912	0.027486967	0.317411471
Pu-238	0.055726117	0.028954378	0.12295477
Co-57	0.04882625	0.02536932	0.292957499
Na-22	0.032640748	0.016959598	0.195844487
Nb-93m	0.025176181	0.013081131	0.217207626
S-35	0.020362259	0.010579896	0.122173554
Th-230	0.018557163	0.009641998	0.11692378
Te-125m	0.017353078	0.009016375	0.104118468
La-140	0.01435878	0.007460587	0.116071625
Pr-144m	0.013737746	0.007137908	0.082426475
Hf-181	0.013016881	0.006763358	0.078101288
Th-231	0.012836551	0.006669662	0.077019308
U-235	0.01224	0.006359704	0.07344
U-233	0.011048072	0.005740397	0.011159001

Table 3-21. (continued).

Radionuclide	Best Estimate (Ci)	Percent of Total (%)	Upper Bound
U-236	0.010423916	0.005416096	0.062543497
Pa-234	0.00803272	0.00417367	0.048196322
Ce-141	0.007453161	0.00387254	0.044718964
Ta-182	0.006945775	0.003608911	0.041674652
Nb-94	0.005421472	0.002816908	0.005421472
I-129	0.186046517	0.096666723	0.187149547
Ba-137	0.004872183	0.002531506	0.004872183
Th-232	0.003668677	0.001906184	0.003668677
Cm-244	0.00291476	0.001514462	0.017488561
Pa-233	0.002913674	0.001513897	0.017482041
Sn-113	0.002552847	0.001326418	0.015317085
Ru-103	0.002180878	0.001133149	0.013085268
Kr-85	0.002129872	0.001106646	0.01277923
Mo-93	0.00199697	0.001037593	0.01198182
Pa-231	0.001647505	0.000856016	0.001757783
Sb-124	0.001605101	0.000833984	0.009630607
I-125	0.001536226	0.000798198	0.009217355
Sr-85	0.001396827	0.000725769	0.008380965
Hf-175	0.001178363	0.000612258	0.007070175
Po-212	0.000969837	0.000503911	0.005819023
In-113m	0.000890015	0.000462437	0.00534009
Th-227	0.000858145	0.000445878	0.005148868
Cd-109	0.000843828	0.000438439	0.005062969
Ir-192	0.000818	0.000425019	0.004908
I-131	0.000776242	0.000403323	0.004657453
Ac-228	0.000738361	0.00038364	0.004430168
U-232	0.000717734	0.000372923	0.004306401
Np-237	0.00061978	0.000322028	0.003718682
Ba-133	0.000572	0.000297202	0.000572
Cd-113m	0.000518	0.000269144	0.003108
Pb-214	0.000446466	0.000231977	0.002678798
Cs-144	0.0004374	0.000227266	0.0026244
Ag-108	0.000388797	0.000202013	0.002332784
Th-228	0.000350562	0.000182146	0.000350562
Sn-123	0.000341808	0.000177598	0.023113882
Pb-212	0.000336057	0.00017461	0.002016342

Table 3-21. (continued).

Radionuclide	Best Estimate (Ci)	Percent of Total (%)	Upper Bound
Mo-99	0.000307335	0.000159686	0.001844012
Bi-212	0.000262582	0.000136434	0.001575495
Bi-214	0.0002525	0.000131195	0.001515
K-40	0.000207221	0.000107669	0.001243326
Te-127m	0.000180766	9.39229E-05	0.000333805
Ce-137	0.000172667	8.97148E-05	0.001036
Gd-153	0.000170432	8.85535E-05	0.00102259
Y-88	0.00016755	8.70562E-05	0.001005299
Sn-119m	0.000165464	8.59726E-05	0.000992787
Tl-208	0.000162582	8.44752E-05	0.000975495
Zr-93	0.319877432	0.166203075	1.919264594
Ag-110	0.000109536	5.6913E-05	0.000657214
Rn-220	0.0000999541	0.000519345	40.35170442
Ra-224	9.97325E-05	5.18194E-05	0.000598395
Ra-228	0.00000708	3.67865E-05	0.0004248
Po-216	4.0802E-05	2.12E-05	0.000244812
Y-91	3.01205E-05	1.56501E-05	0.000180723
Cs-135	2.10694E-05	1.09473E-05	0.000126417
Ce-134	0.00000156	8.1055E-06	0.0000936
Np-239	1.14671E-05	5.95812E-06	6.88026E-05
Am-243	1.13712E-05	5.9083E-06	1.13712E-05
U-237	1.07081E-05	5.56376E-06	1.07081E-05
Cm-242	1.05721E-05	5.4931E-06	6.34328E-05
Ce-139	8.55315E-06	4.44408E-06	5.13189E-05
Th-229	8.05759E-06	4.18659E-06	4.83455E-05
Ra-225	6.48962E-06	3.3719E-06	3.89377E-05
Ac-225	5.91186E-06	3.0717E-06	3.54712E-05
At-217	5.31133E-06	2.75968E-06	3.1868E-05
Bi-213	4.30548E-06	2.23706E-06	4.30548E-06
Fr-221	3.35023E-06	1.74073E-06	1.49659E-05
Po-213	0.00000028	1.45483E-06	0.0000168
Sn-126	2.53348E-06	1.31635E-06	2.53348E-06
Am-242m	2.52546E-06	1.31219E-06	2.52546E-06
Ac-227	2.51546E-06	1.30699E-06	1.50928E-05
Po-218	2.51546E-06	1.30699E-06	1.50928E-05
Rn-222	2.51546E-06	1.30699E-06	1.50928E-05

Table 3-21. (continued).

Radionuclide	Best Estimate (Ci)	Percent of Total (%)	Upper Bound
Po-214	2.51546E-06	1.30699E-06	1.50928E-05
Bi-210	2.46534E-06	1.28095E-06	1.4792E-05
Pb-210	2.30085E-06	1.19548E-06	1.38051E-05
Po-210	2.09255E-06	1.08725E-06	1.25553E-05
Pd-107	9.59854E-07	4.98724E-07	5.75912E-06
Cm-243	5.82498E-07	3.02656E-07	3.49499E-06
Pb-209	5.82498E-07	3.02656E-07	3.49499E-06
Tl-209	5.75828E-07	2.99191E-07	3.45497E-06
Pu-242	5.27308E-07	2.7398E-07	3.16385E-06
U-228	5.09308E-07	2.64628E-07	3.05585E-06
Cm-246	5.06944E-07	2.634E-07	3.04166E-06
Cm-245	2.50887E-07	1.30357E-07	1.50532E-06
Cd-113	8.6618E-08	4.50053E-08	5.19708E-07
Cl-36	5.4318E-08	2.82227E-08	3.25908E-07
Be-10	5.4318E-08	2.82227E-08	3.25908E-07
Pu-236	4.10137E-08	2.131E-08	2.46082E-07
P-32	0.000000024	1.247E-08	0.000000024
Gd-152	1.617E-09	8.40167E-10	9.702E-09
Sn-117m	1.6149E-09	8.39076E-10	9.6894E-09
Sr-89	1.635E-10	8.49519E-11	9.81E-10
Te-132	1.345E-10	6.9884E-11	8.07E-10
Y-90	1.043E-10	5.41926E-11	6.258E-10
Mn-54	8.1E-11	4.20863E-11	4.86E-10
Ni-63	1.352E-11	7.02477E-12	8.112E-11
Ce-144	1.54334E-18	8.01893E-19	9.26002E-18
Pr-144	0	0	0
Zr-95	0	0	0
Tc-99	0	0	0
Ru-106	192.461802	100	

a. These waste generators are minor contributors.

Table 3-22. Inventory of radiological contaminants (listed alphabetically) from other waste generators^a for the years 1994 to 1999 (activity at time of disposal).

Radionuclide	Best Estimate (Ci)	Percent of Total (%)	Upper Bound
Ac-225	2.51546E-06	1.30699E-06	1.50928E-05
Ac-227	9.59854E-07	4.98724E-07	5.75912E-06
Ac-228	0.000388797	0.000202013	0.002332784
Ag-108	0.000207221	0.000107669	0.001243326
Ag-108m	0.052901912	0.027486967	0.317411471
Ag-110	0.0000156	8.1055E-06	0.0000936
Ag-110m	0.114549041	0.059517806	0.687294248
Am-241	0.025176181	0.013081131	0.217207626
Am-242m	2.09255E-06	1.08725E-06	1.25553E-05
Am-243	5.31133E-06	2.75968E-06	3.1868E-05
At-217	2.51546E-06	1.30699E-06	1.50928E-05
Ba-133	0.000336057	0.00017461	0.002016342
Ba-137	0.00199697	0.001037593	0.01198182
Ba-137m	6.673637069	3.467512514	58.0570199
Ba-140	0.017353078	0.009016375	0.104118468
Be-10	1.043E-10	5.41926E-11	6.258E-10
Bi-210	5.27308E-07	2.7398E-07	3.16385E-06
Bi-212	0.000165464	8.59726E-05	0.000992787
Bi-213	2.51546E-06	1.30699E-06	1.50928E-05
Bi-214	0.000162582	8.44752E-05	0.000975495
C-14	0.356522148	0.185243069	2.139132888
Cd-109	0.000518	0.000269144	0.003108
Cd-113	1.635E-10	8.49519E-11	9.81E-10
Cd-113m	0.000307335	0.000159686	0.001844012
Ce-134	6.48962E-06	3.3719E-06	3.89377E-05
Ce-137	0.000999541	0.000519345	40.35170442
Ce-139	0.0000028	1.45483E-06	0.0000168
Ce-141	0.002913674	0.001513897	0.017482041
Ce-144	0.88275108	0.458663003	5.296506478
Cl-36	1.345E-10	6.9884E-11	8.07E-10
Cm-242	3.35023E-06	1.74073E-06	1.49659E-05

Table 3-22. (continued).

Radionuclide	Best Estimate (Ci)	Percent of Total (%)	Upper Bound
Cm-243	8.6618E-08	4.50053E-08	5.19708E-07
Cm-244	0.001605101	0.000833984	0.009630607
Cm-245	1.6149E-09	8.39076E-10	9.6894E-09
Cm-246	1.617E-09	8.40167E-10	9.702E-09
Co-57	0.013737746	0.007137908	0.082426475
Co-58	0.409780803	0.212915393	2.458684818
Co-60	11.50705096	5.978875207	23.01550411
Cr-51	0.2709282	0.140769855	1.625569198
Cs-134	0.23221058	0.120652814	1.393263478
Cs-135	8.05759E-06	4.18659E-06	4.83455E-05
Cs-137	10.72107237	5.570493604	24.62600009
Cs-144	0.0002525	0.000131195	0.001515
Eu-152	0.15742927	0.08179767	0.944121618
Eu-154	0.065044531	0.033796073	0.39190992
Eu-155	0.379366764	0.197112757	2.286912131
Fe-55	24.3146014	12.63346864	48.63206761
Fe-59	0.133787535	0.069513812	0.80272521
Fr-221	2.51546E-06	1.30699E-06	1.50928E-05
Gd-152	1.54334E-18	8.01893E-19	9.26002E-18
Gd-153	9.97325E-05	5.18194E-05	0.000598395
H-3	82.1830487	42.70096603	13.09829221
Hf-175	0.000738361	0.00038364	0.004430168
Hf-181	0.006945775	0.003608911	0.041674652
I-125	0.000818	0.000425019	0.004908
I-129	0.002129872	0.001106646	0.01277923
I-131	0.0004374	0.000227266	0.0026244
In-113m	0.00061978	0.000322028	0.003718682
Ir-192	0.000446466	0.000231977	0.002678798
K-40	0.319877432	0.166203075	1.919264594
Kr-85	0.000969837	0.000503911	0.005819023
La-140	0.00803272	0.00417367	0.048196322
Mn-54	4.342574248	2.256330453	26.05544549

Table 3-22. (continued).

Radionuclide	Best Estimate (Ci)	Percent of Total (%)	Upper Bound
Mo-93	0.000890015	0.000462437	0.00534009
Mo-99	0.00016755	8.70562E-05	0.001005299
Na-22	0.013016881	0.006763358	0.078101288
Nb-93m	0.012836551	0.006669662	0.077019308
Nb-94	0.002180878	0.001133149	0.013085268
Nb-95	0.543537389	0.282413125	3.261224334
Ni-59	0.032640748	0.016959598	0.195844487
Ni-63	3.189978438	1.657460548	6.479957132
Np-237	0.000341808	0.000177598	0.023113882
Np-239	5.91186E-06	3.0717E-06	3.54712E-05
P-32	1.352E-11	7.02477E-12	8.112E-11
Pa-231	0.000858145	0.000445878	0.005148868
Pa-233	0.001536226	0.000798198	0.009217355
Pa-234	0.00291476	0.001514462	0.017488561
Pa-234m	0.364471482	0.189373413	2.186828894
Pb-209	5.4318E-08	2.82227E-08	3.25908E-07
Pb-210	5.09308E-07	2.64628E-07	3.05585E-06
Pb-212	0.000170432	8.85535E-05	0.00102259
Pb-214	0.000262582	0.000136434	0.001575495
Pd-107	2.50887E-07	1.30357E-07	1.50532E-06
Pm-147	25.9543154	13.48543718	168.4769059
Po-210	5.06944E-07	2.634E-07	3.04166E-06
Po-212	0.000717734	0.000372923	0.004306401
Po-213	2.46534E-06	1.28095E-06	1.4792E-05
Po-214	5.75828E-07	2.99191E-07	3.45497E-06
Po-216	1.05721E-05	5.4931E-06	6.34328E-05
Po-218	5.82498E-07	3.02656E-07	3.49499E-06
Pr-144	0.881236338	0.457875968	5.287418028
Pr-144m	0.007453161	0.00387254	0.044718964
Pu-236	8.1E-11	4.20863E-11	4.86E-10
Pu-238	0.01435878	0.007460587	0.116071625
Pu-239	0.061589474	0.032000882	0.37511765

Table 3-22. (continued).

Radionuclide	Best Estimate (Ci)	Percent of Total (%)	Upper Bound
Pu-240	0.018557163	0.009641998	0.11692378
Pu-241	0.387513959	0.201345906	2.389893099
Pu-242	4.10137E-08	2.131E-08	2.46082E-07
Ra-224	1.13712E-05	5.9083E-06	1.13712E-05
Ra-225	2.52546E-06	1.31219E-06	2.52546E-06
Ra-226	0.074079077	0.038490275	0.074079077
Ra-228	1.07081E-05	5.56376E-06	1.07081E-05
Rh-106	0.561378118	0.291682875	3.368268706
Rn-220	1.14671E-05	5.95812E-06	6.88026E-05
Rn-222	5.82498E-07	3.02656E-07	3.49499E-06
Ru-103	0.001178363	0.000612258	0.007070175
Ru-106	0.607233308	0.315508481	3.643399849
S-35	0.01224	0.006359704	0.07344
Sb-124	0.000843828	0.000438439	0.005062969
Sb-125	0.164468857	0.085455324	1.070075147
Sc-46	0.04882625	0.02536932	0.292957499
Sm-151	0.020362259	0.010579896	0.122173554
Sn-113	0.001396827	0.000725769	0.008380965
Sn-117m	0	0	0
Sn-119m	4.0802E-05	2.12E-05	0.000244812
Sn-123	0.000172667	8.97148E-05	0.001036
Sn-126	2.30085E-06	1.19548E-06	1.38051E-05
Sr-85	0.000776242	0.000403323	0.004657453
Sr-89	0	0	0
Sr-90	9.220731095	4.790940851	69.52483364
Ta-182	0.002552847	0.001326418	0.015317085
Tc-99	0.642868796	0.334024097	3.857460762
Te-125m	0.010423916	0.005416096	0.062543497
Te-127m	0.000109536	5.6913E-05	0.000657214
Te-132	0	0	0
Th-227	0.000572	0.000297202	0.000572
Th-228	0.000180766	9.39229E-05	0.000333805

Table 3-22. (continued).

Radionuclide	Best Estimate (Ci)	Percent of Total (%)	Upper Bound
Th-229	2.53348E-06	1.31635E-06	2.53348E-06
Th-230	0.011048072	0.005740397	0.011159001
Th-231	0.005421472	0.002816908	0.005421472
Th-232	0.001647505	0.000856016	0.001757783
Th-234	0.365490824	0.189903046	0.365490824
Tl-208	3.01205E-05	1.56501E-05	0.000180723
Tl-209	5.4318E-08	2.82227E-08	3.25908E-07
U-228	0.000000024	1.247E-08	0.000000024
U-232	0.000350562	0.000182146	0.000350562
U-233	0.004872183	0.002531506	0.004872183
U-234	0.055726117	0.028954378	0.12295477
U-235	0.186046517	0.096666723	0.187149547
U-236	0.003668677	0.001906184	0.003668677
U-237	4.30548E-06	2.23706E-06	4.30548E-06
U-238	0.404902105	0.210380502	0.522832207
Y-88	0.0000708	3.67865E-05	0.0004248
Y-90	4.425874294	2.299611792	25.02322257
Y-91	8.55315E-06	4.44408E-06	5.13189E-05
Zn-65	0.067108159	0.0348683	0.402648952
Zr-93	2.10694E-05	1.09473E-05	0.000126417
Zr-95	0.862918599	0.448358371	5.177511596
Total	192.461802	100	—

a. These are minor waste generator contributors.

4. REFERENCES

- 10 CFR 61, *Code of Federal Regulations*, Title 10, "Energy," Part 61, "Licensing Requirements for Land Disposal of Radioactive Waste."
- 40 CFR 261, Appendix II, 2002, Title 40, "Protection of Environment," Part 261, "Identification and Listing of Hazardous Waste," Appendix II, "Method 1311, Toxicity Characteristic Leaching Procedure," *Code of Federal Regulations*, Office of the Federal Register.
- 42 USC § 6901 et seq., October 21, 1976, *United States Code*, "Resource Conservation and Recovery Act (Solid Waste Disposal Act.)"
- 42 USC § 9601 et seq., December 11, 1980, *United States Code*, "Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA/Superfund)."
- Akers, D. W., 1994, *TRA Activity Weighting Factors/Physical and Chemical Properties of C-14, Tc-99 and I-129*, Engineering Design File ER-WAG 7-51, Idaho National Engineering and Environmental Laboratory, EG&G Idaho, Inc., Idaho Falls, Idaho.
- ANL-W, 2001, Argonne National Laboratory-West website, <http://www.anl.gov/OPA/progs.htmlsf>, Idaho National Engineering and Environmental Laboratory, Argonne National Laboratory-West, Idaho Falls, Idaho.
- Barg, D. C., 2000, *Determination of Limits for Depleted Uranium Containing Transuranic and Fission Product Materials*, Engineering Design File SMC-2000-001, Idaho National Engineering and Environmental Laboratory, Bechtel BWXT LLC, Idaho, Idaho Falls, Idaho.
- Best, W. T., and A. D. Miller, 1987, *Updated Scaling Factors in Low-Level Radwaste*, EPRI NP-5077, Impell Corporation, Walnut Creek, California, Electric Power Research Institute, Palo Alto, California,.
- Best, W. T, A. D. Miller, R. Wessman, and L. Leventhal, 1985, *Radionuclide Correlations in Low-Level Radwaste*, EPRI NP-4037, Impell Corporaton, Walnut Creek, California.
- Croff, A. G., 1980, *ORIGEN2—A Revised and Updated Version of the Oak Ridge Generation and Depletion Code*, ORNL-5G21, Oak Ridge National Laboratory, Oak Ridge, Tennessee.
- DOE-ID, 1998, *Radioactive Waste Management Information for 1997 and Record to Date—RWMIS Report*, DOE/ID-10054, Rev. 0, U.S. Department of Energy Idaho Operations Office, Idaho Falls, Idaho.
- DOE, 1995a, "Draft Environmental Assessment: Test Area North Pool Stabilization Project (Draft)," U.S. Department of Energy.
- DOE, 1995b, *Settlement Agreement*, U. S. Department of Energy, Environmental Management; U.S. Department of the Navy, Naval Nuclear Propulsion Program; and the State of Idaho, October 17, 1995.
- DOE-ID, 1991, *Federal Facility Agreement and Consent Order for the Idaho National Engineering Laboratory*, Administrative Record No. 1088-06-29-120, U.S. Department of Energy Operations

Office; U.S. Environmental Protection Agency, Region 10; Idaho Department of Health and Welfare, December 4, 1991.

Einerson, J. J., 1995, *Estimation and Application of Scaling Factor Uncertainties for the Historical Data Task and the Recent and Projected Data Task*, Engineering Design File ER-WAG 7-62, Idaho National Engineering and Environmental Laboratory, Lockheed Martin Idaho Technologies Company, Idaho Falls, Idaho.

Einerson, J. J., and T. H. Smith, 1995, *Estimation and Application of Scaling Factor Uncertainties for the Historical Data Task and the Recent and Projected Data Task*, Engineering Design File EDF-ER-WAG 4-62, 95/081, Idaho National Engineering and Environmental Laboratory, Lockheed Martin Idaho Technologies Company, Idaho Falls, Idaho.

EPRI, 1987, *Updated Scaling Factors in Low-Level Radwaste*, EPRINP-5077, Electric Power Research Institute, Palo Alto, California.

Evans, J. C., E. L. Lepel, R. W. Sanders, C. L. Wilkerson, W. Silker, C. W. Thomas, K. H. Abel, and D. R. Robertson, 1984, *Long-Lived Activation Products in Reactor Materials*, NUREG/CR-3474, Pacific Northwest Laboratory, Battelle Memorial Institute, Richland, Washington.

Harker, Y. D., 1995, *Scaling Factors for Waste Activities Measured by G-M Method*, Engineering Design File ER-WAG 7-57, Idaho National Engineering and Environmental Laboratory, Lockheed Martin Idaho Technologies Company, Idaho Falls, Idaho.

INEL, 2001, *Idaho National Engineering and Environmental Laboratory Comprehensive Facility and Land Use Plan*, Idaho National Engineering and Environmental Laboratory, Idaho Falls, Idaho, URL: <http://mceris.inel.gov/>.

LMITCO, 1995a, *A Comprehensive Inventory of Radiological and Nonradiological Contaminants in Waste Buried or Projected to Be Buried in the Subsurface Disposal Area of the INEL RWMC During the Years 1984–2003*, INEL-95/0135, Idaho National Engineering and Environmental Laboratory, Lockheed Martin Idaho Technologies Company, Idaho Falls, Idaho.

LMITCO, 1995b, *A Comprehensive Inventory of Radiological and Nonradiological Contaminants in Waste Buried in the Subsurface Disposal Area of the INEL RWMC During the Years 1952–1983*, INEL-95/0310, Idaho National Engineering Laboratory, Lockheed Martin Idaho Technologies Company, Idaho Falls, Idaho.

Sheldon, D. E., Interoffice Facsimile to J. Grande, November 7, 2000, “Major Isotopic Constituents in SMC Depleted Uranium-Bearing Wastes (Cu) Conversion Factors,” Idaho National Engineering and Environmental Laboratory, Bechtel BWXT LLC, Idaho, Idaho Falls, Idaho.

Tyger, G. L., 1999, *Radioactive Waste Characterization Requirements for Reactor-Generated Low-Level Waste*, Engineering Design File WROC-EDF-392, Rev. 1, Idaho National Engineering and Environmental Laboratory, Lockheed Martin Idaho Technologies, Idaho Falls, Idaho.

Vance, J. N., 1988, *Assessing the Impact of NRC Regulation 10 CFR 61 on the Nuclear Industry*, EPRI NP-5983, Research Project 2412-6, Final Report, Ruidoso, New Mexico.

WGS, 1996, Waste Generator Services Certificate, Waste Shipment Form, Waste Generator Services.

Zagula, T. A., 1995, *A Modern Depleted Uranium Manufacturing Facility*, INEL-95-00265, Idaho National Engineering and Environmental Laboratory, Lockheed Martin Idaho Technologies Company, Idaho Falls, Idaho.

Appendix A

Standardized Five-Page Data Form Used Previously to Compile and Record Subsurface Disposal Area Waste Data

Appendix A

Standardized Five-Page Data Form Used Previously to Compile and Record Subsurface Disposal Area Waste Data

This appendix presents three items related to collecting the information on the contaminant inventories.

The first item is a blank, five-page data collection form. One data form was completed for each identified waste stream disposed of in the Subsurface Disposal Area. Continuation pages were added to the form as necessary. The Contaminant Inventory Database for Risk Assessment (CIDRA) was modeled after this form. Completed forms for all identified waste streams are stored in CIDRA and constitute Appendix B of this report.

The second item is a list of the general physical forms represented in the waste. The list is used in the database compilation of the inventory to facilitate the rollup of all waste streams having a similar physical form, regardless of the generator or building that produced the waste.

The third item is a list of the general container types used for the waste at the SDA. The abbreviations match those used in the Radioactive Waste Management System (RWMIS) database.

DATA INPUT FOR RECENT AND PROJECTED DATA TASK FOR RWMC SUBSURFACE DISPOSAL AREA

PART A - GENERAL INFORMATION

1. Preparer _____
2. Date prepared _____
3. Generator _____
(area or contractor - use code from attached list)
4. Particular facility _____
(building number - use code from attached list)
5. Number of the waste stream from this facility _____
6. Waste stream _____
7. Type of radioactive waste (check box)
 TRU or suspect TRU
 LLW
 non-radioactive
8. Actual years disposed of at SDA
Starting year _____ Ending year _____
9. Waste stream volume
Amount _____ Units _____
Check box: annual or total over all years
Check box: container volume or waste volume
10. Comments (specify number of pertinent question) _____

PART B - WASTE STREAM CHARACTERISTICS

- | | |
|---|---|
| <p>1. General physical form (see attached list)</p> <p><input type="checkbox"/> other (specify) _____</p> | <p>2. Details on physical form (particularly confinement related)</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> |
| <p>3. Chemical form</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> | <p>4. Inner packaging: <input type="checkbox"/> plastic bag <input type="checkbox"/> plastic liner <input type="checkbox"/> metal liner</p> <p><input type="checkbox"/> none <input type="checkbox"/> other (specify) _____</p> <p>_____</p> <p>_____</p> <p>_____</p> |
| <p>5. Waste container type (see attached list)</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> | <p>6. Other characteristics of interest</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> |
| <p>7. Comments (specify number of pertinent question)</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> | |

PART C - NONRADIOLOGICAL CONTAMINANTS

For each contaminant, complete at least one line on the following table. If any entries for that contaminant vary by year, fill out additional lines as needed to cover the varying entries for different years. For example, if the annual quantity disposed was x kg for 1952-56 and y kg for 1957-84, use two lines to handle this situation.

- * If sample data are available, mark Y in the column titled "Samples?" and provide number of samples in the next column and standard deviation in the next column. If not, mark N and give the minimum value and maximum value.

Additional information or explanations (indicate pertinent contaminant)

PART D - RADIOLOGICAL CONTAMINANTS

- * If sample data are available, mark Y in the column titled "Samples?" and provide number of samples in the next column and standard deviation in the next column. If not, mark N and give minimum value and maximum value.
 - ** For the projected waste streams, mark Y if forecast document was used. If not, mark N. This column is not used for the recent waste streams.

Additional information or explanations (indicate pertinent contaminant).

PART E - SOURCES OF INFORMATION AND UNCERTAINTIES

1. Type of source of information
(check box)

- RWMIS other database
- sample analysis data
- operating records interview
- expert judgment reports
- generator forecasts
- other (specify) _____

2. Details concerning source [names, report no., dates, etc.]

3. Do the estimates of contaminant
quantities in Part C and D represent:
(check box)

- best estimate
- worst case
- other (specify) _____

4. If other than best estimate, explain why

5. Do the data conflict with RWMIS?
 no
 yes

7. Major unknowns in inventories of
contaminants

8. Key assumptions used to deal with the unknowns

CONTINUATION PAGE

Continuation of Part _____, Column or Question Number or Title _____

**GENERAL PHYSICAL FORMS FOR
WASTE BURIED IN THE SUBSURFACE DISPOSAL AREA**

<u>Number</u>	<u>Form</u>
1	Irradiated fuel rods from experiments
2	Irradiated fuel from experiments
3	Unirradiated fuel from experiments
4	Irradiated end boxes
5	Other core, reactor vessel, and loop components
6	Ventilation systems
7	Lead
8	Beryllium
9	Zirconium
10	Other scrap metals
11	Sludge
12	Resin
13	Vermiculite and other sorbents
14	Evaporated salts
15	Other liquid setups
16	Graphite
17	Reactive metals
21	Combustibles (paper, cloth, wood, etc.)
22	HEPA filters
23	Other filters
24	Biological waste
31	Radiation sources
41	Concrete, brick, asphalt
42	Glass
43	Soil
44	Plastics
45	Rubber
46	Soot, ash
47	Asbestos
51	Liquids
52	Unknown
53	Other